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Final Report

1.1-15

Sulphur Fertilizer Response on Field Peas

Conducted by Jim Ferrie

Funded by the Agriculture Development Fund

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Saskatchewan Wheat Pool

SULPHUR FERTILIZER RESPONSE ON FIELD PEAS

1989 ANNUAL REPORT

BY

JIM FERRIE

FIELD AGRONOMIST

PRODUCT DEVELOPMENT

ERDA RESEARCH PROJECT

BY

SASKATCHEWAN DEPARTMENT OF AGRICULTURE

SASKATCHEWAN PULSE CROP DEVELOPMENT BOARD

SASKATCHEWAN WHEAT POOL, PRODUCT DEVELOPMENT

JANUARY, 1990

PRODUCT DEVELOPMENT

1.1-15

TITLE: The effect of sulphur fertilizer application on the growth and yield of Victoria field pea (Pisum sativum).

DATE: January, 1990.

OBJECTIVE

1. Determine the effect of sulphate fertilizer on the growth and yield of Victoria field pea.

2. Determine the effect of the method of application (broadcast vs banding) on the response of sulphate fertilizer on field pea.

3. Determine the effect of the time of application (fall vs spring) on the response to sulphate fertilizer on Victoria field pea.

PROJECT MANAGER: Jim Ferrie

INTRODUCTION

The estimated acreage for field pea production for 1989 was 200,000 acres which is a sharp decline from 425, 000 acres of 1988. The reduction in field pea acreage has been a result of price reduction relative to wheat and low yields due to weather conditions.

In 1989, the average yield field pea rose to about 19 bus/ac from dismal 13.5 bus/ac in 1988.

Weather conditions were more favourable in the northeastern part of Saskatchewan, though still not good growing conditions for field pea production.

Field pea production will find a rotational niche in the northeastern part of the province as farmers move towards more sustainable methods of agriculture.

A field pea crop can extend the crop rotation especially for producers facing potential blackleg problems in canola. The nitrogen fixing component of the legume either alone or intercropped with canola will help reduce nitrogen fertilizer inputs.

Sulphur deficiencies have been occurring in the grey black and grey soils for two main reasons. First, the limited ability of these soils to provide sulphur to the plants during the growing season by mineralization of organic material. Secondly, the high sulphur demand required by crops such as canola and alfalfa.

The requirement for sulphur for field pea production is not well understood which has prompted this study. The study will aid in provding information for a soil test requirements and through the extension portion provide agronomic information on the production of field pea.

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CONCLUSIONS

1. The environmental conditions such as above 30 degree C temperatures in July limited yield potential of field peas in the north eastern corner of the province.

2. The time of application (spring versus fall) had no significant effect on yield or dry matter weight.

3. The method of application (band versus broadcast) had no significant effect on yield or dry matter weight.

4. The rate of sulphur fertilizer had no significant effect on yield or dry matter weight at five out of the six sites.

5. The rate of sulphur fertilizer had no effect on vine length at five out of the six sites.

6. The concentration of sulphur and nitrogen on average was greater for 40 kg/ha SO_4-S treatment than for the 0 kg/ha SO_4-S treatment.

7. The nitrogen and sulphur concentration decreased as the plant stages progressed from the sixth node to podding.

ACTIVITIES

During the growing season the field pea plants had no difference in colour between the 0 kg/ha and 40 kg/ha of sulphate-sulphur treatments. In addition, no visual differences in growth could be detected between the check and the highest sulphur treatment.

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Sulphur field pea sites were scheduled to be part of the Saskatchewan Wheat Pool tour on June 28, (farmer tour) and July 11, (staff tour). The tour for June 28, was advertised in the Nipawin journal. An air conditioned coach was chartered, and a bar-b-que lunch was prepared. Elevator Agents and Service Centre staff phoned producers informing them the tour date.

Then the rain came, the tour was rescheduled for July 11, to include both farmers and staff members.

On July 11, the rain came again, the tour was cancelled. The tour finally took place on July 24, as part of the Larry Lee's (extension agrologist) tour.

All sulphur-field pea sites were identified as Ag. Development Fund, Pulse Crop Development Board and Saskatchewan Wheat Pool.

Two locations were very visible along highway #35, plus 2 sites were located along main grid roads. Two sites were located to accommodate specific soil types and low soil sulphur levels.

Weather conditions hasten the ripening of the crop during late July and early August.

Temperatures greater than 30 degree celsius, reduced the yield potential. At most sites rainfall was close to normal, however, sub-soil moisture was still at a deficit from last year's drought.

On August 9, 10, and 11, eight plants from each plot were bagged for future weighing to determine harvest index. On August 14, 15, 16, plots were combined by a small plot combine.

At the time of writing sulphur and nitrogen concentrations on seed and straw per each plot had yet to be analyzed.

A sulphur incubation study of the six soil types will begin in January 1990, to determine to rate of mineralization of sulphur.

An article will be submitted to Saskatchewan Wheat Pool, Product Development newsletter which has a circulation of approximately 1000.

A poster on the sulphur pea project will be display at the Saskatchewan Pulse Crop Development Board meeting during Farm and Home Week.

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MATERIALS AND METHODS

The experiment is structured as a randomized split: split plot design which consists of the following:

5 fertilizer treatments
2 methods of application
2 application times
5 replications
6 locations

The total number of plots was 600.

The study consists of determining the response of sulphate fertilizer on field pea and the effect the time of application and the method of application have on the fertilizer response. The five fertilizer treatments included 0, 10, 20, 30, 40 kg/ha of sulphate-sulphur. The time and method of application of the fertilizer is fall versus spring and band versus broadcast respectively. The twenty different combinations of treatments were repeated five times and at six different site locations which totalled 600 plots.

The test sites were located in northeast corner of the province on grey and grey black soil zones where sulphur deficient soils determined by soil test to the 60 cm depth.

Ammonium sulphate 20-0-0-24 (granular prill) was the source of sulphur fertilizer in the study while ammonium nitrate 34-0-0 (granular prill) was the source of nitrogen fertilizer which was applied to balance the nitrogen among treatments. Other macro nutrients such as phosphorus, and potassium were applied according to soil test recommendations.

Nitrogen was maintained at 60 kg/ha of actual nitrogen for each treatment by balancing the amount of ammonium nitrate with the ammonium sulphate applied.

The Product Development (1.5 meter) high clearance hoe drill was used to perform the fertilizer band and broadcast operations at 30 cm row spacings and seed at 15 cm row spacings. Cultivation by hoe shanks occurred on both band and broadcast treatments to eliminate tillage as a variable in the experiment.

Victoria, field pea Pisum sativum was inoculated with Rhizogen rhizobium and sown at a rate of 160 kg/ha between May 5 to 10 at the 6 sites. The plots received application of trifluralin (Treflan) in the fall and Sethoxydim (Poast) and Bentazon (Basagran) or MCPB + MCPA (Tropotox plus) in the spring for weed control.

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TISSUE ANALYSIS

Sulphur and nitrogen concentrations were evaluated during the growing season on the spring band method of application by tissue sampling and analysis.

Tissue sampling were taken from treatments 0 and 40 kg/ha at two locations on 2 replicates at the node stages of 6, 11, 13 and podding of the plants during the month of May, June and July. Other parameters that were evaluated were the following:

a. Yield determined by small plot combine sample
b. Dry matter yield at harvest time
c. Nitrogen content in seed and straw
d. Sulphur content in seed and straw

GROWING SEASON CONDITIONS

The weather conditions were more favourable in 1989 than in 1988, though the lack of timely precipitation and high temperatures did reduce yield potential. Temperatures greater than 30 degree C occurred in late July and early August hasten ripening of the field pea plots. The sites were harvested early, therefore, did not utilize any August precipitation.

The coarse textured soil sites, Sandhill and Pontrilas did not receive the rainfall that occurred at Nipawin airport (Table 1) in July. All sites, especially Sandhill and Pontrilas were still at a sub soil moisture deficit from last year's drought.

TABLE 1. RAIN FALL & MEAN TEMPERATURE AT NIPAWIN AIRPORT

Rain Fall (mm)	April	May	June	July	August
1989	9.4	62	91	41.6	105
30 year average	22.8	39.5	61.0	67.6	55.9
% of normal	42	157	149	62	188
Temperature (degree C)					
1989	2.9	11.6	15.7	19.5	16.4
30 year average	2.0	10.5	15.7	18.4	17.3
Plus or minus normal	+ .9	+ 1.1	0	+ 1.1	- .9

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TABLE 2. THE EFFECT OF APPLICATION TIME, APPLICATION METHOD AND SO_4-S RATES ON GRAIN YIELD ON VICTORIA FIELD PEA 1989 (KG/HA)

	Location					
	Garrick	White Fox	Nipawin	Codette	Pontrilas	Sandhill
Main Treatment - Fall	1287a	2014a	1898a	1885a	1023a	796a
Spring	1157a	2053a	1873a	1828a	924a	1067a
Sub-Treatment - Band	1249a	2043a	1868a	1890a	979a	866a
Broadcast	1195a	2024a	1902a	1824a	969a	998a
Other Treatment						
0 kg/ha	1287a	2017a	1851a	1889a	1014a	933a
10 kg/ha	1217ba	2034a	1887a	1859a	928a	927a
20 kg/ha	1230ba	2043a	1923a	1822a	984a	941a
30 kg/ha	1252a	2027a	1902a	1869a	968a	956a
40 kg/ha	1123b	2047a	1863a	1845a	978a	903a
C.V.	14.2	6.9	9.8	9.6	20.8	23.8

Means with the same letter are not significantly different.

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TABLE 3. GRAIN YIELD ANALYSIS OF VARIANCE
SULPHUR FIELD PEA PROJECT 1989

		Location					
		Garrick	White Fox	Nipawin	Codette	Pontrilas	Sandhill
Source	df	SS	SS	SS	SS	SS	SS
Rep	4	1367515	4313912**	1970709**	210923	3856069	522222
Main Treatment	1	424452	38220	14617	81510	242454	1802287
Sub-Treatment	1	82630	9235	29964	108702	2495	425569
Main Trt - Sub-Trt	1	55743	12837	6100	39880	297179	1068105
Rep M Trt - Sub-Trt	12	2055649	1165742	599427	542243	5320535	5857946
Other Treatment	4	299638	11843	67258	49162	75892	30109
Main Trt - Other	4	103148	4302	128293	34855	236529	44861
Sub Trt - Other	4	189329	25669	153334	15679	372775	52474
Main Trt - Sub-Trt Other	4	49759	25135	42741	111713	111936	182854
Error	64	1930163	1246628	2168710	2041991	2593799_{ε}	3056777_{ι}
C.V.		14.2	6.9	9.8	9.6	20.8	23.8

SS = Denotes sum of squares
$_{\varepsilon}$ = Degrees of freedom 63 } * Significant at 5% level
$_{\iota}$ = Degrees of freedom 62 } * * Significant at 1% level

Main Treatments = Application time (fall vs spring)
Sub Treatments = Application method (band vs broadcast)
Other Treatments = (0, 10, 20, 30, 40 (kg/ha of SO_4-S))

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TABLE 4. THE EFFECT OF APPLICATION TIME, APPLICATION METHOD AND SO_4-S RATES ON DRY MATTER WEIGHT OF VICTORIA FIELD PEA 1989 (GRAMS/SUB SAMPLE)

	Location					
	Garrick	White Fox	Nipawin	Codette	Pontrilas	Sandhill
Main Treatment - Fall	58.3a	52.4a	66.0a	68.6a	44.7a	37.3a
- Spring	60.4a	55.2a	63.3a	71.8a	48.1a	34.4a
Sub Treatment - Band	58.4a	54.6a	63.5a	71.7a	48.2a	33.8a
Broadcast	60.3a	53.0a	65.8a	68.7a	44.6a	37.9a
Other Treatment						
0 kg/ha	55.5a	50.6b	65.0a	33.8a	45.8a	33.8a
10 kg/ha	58.5a	50.7b	65.4a	34.3a	47.1a	34.3a
20 kg/ha	61.2a	58.3a	60.1a	35.1a	42.0a	35.1a
30 kg/ha	61.3a	55.6ba	65.4a	39.0a	51.0a	39.0a
40 kg/ha	60.4a	54.0ba	67.5a	37.1a	46.2a	37.1a
C.V.	21.3	19.0	18.1	20.3	32.3	28.9

Means with the same letter are not significantly different

Sub Sample = Eight plants per plot

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TABLE 5. DRY MATTER WEIGHT ANALYSIS OF VARIANCE
SULPHUR FIELD PEA PROJECT 1989

		Location					
		Garrick	White Fox	Nipawin	Codette	Pontrilas	Sandhill
Source	df	SS	SS	SS	SS	SS	SS
Rep	4	1264	4631	11838**	1485	12197*	4815
Main Treatment	1	117	190	185	262	303	219
Sub Treatment	1	96	64	130	225	317	408
Main Trt * Sub Trt	1	149	282	1.0	324	1075	9.0
Other Treatment	4	475	863	597	1554	820	372
Main Trt * Other	4	922	815	229	230	503	133
Sub-Trt - Other	4	1195	1100	471	959	1384	417
Main Trt - Sub Trt Other	4	799	193	523	1628	321	154
Error	64	10269	6684	8679	13000	14289	6867
C.V.		21.3	19.0	18.1	20.3	32.2	28.9

Main Treatments = Application time (fall vs spring)
Sub Treatments = Application method (bad vs broadcast)
Other Treatments = (0, 10, 20, 30, 40 kg/ha of SO_4-S)

SS = Sum of Squares
* = Significant of 5% level
** = Significant of 1% level

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TABLE 6. 1989 FIELD PEA VINE LENGTH (CM)
0 AND 40 KG/HA OF SO_4-S, TREATMENTS

Treatment kg/ha	Garrick		White Fox		Nipawin		Codette		Pontrilas		Sandhill		Mean	
Main Treatment	0	40	0	40	0	40	0	40	0	40	0	40	0	40
Spring Band	56	63	58	60	63	61	68	66	55	56	52	46	59	59
Spring Broadcast	59	51	59	56	58	60	63	65	53	56	47	47	57	56
Fall Band	63	64	59	59	62	59	65	66	63	56	47	46	60	58
Fall Broadcast	63	64	61	60	64	63	63	64	70	66	62	59	64	63
Mean	60	71	59	59	62	61	65	65	60	59	52	50	60	59

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TABLE 7. 1989 FIELD PEA TISSUE ANALYSIS OF 0 AND 40 KG/HA SO_4-S SPRING BAND TREATMENTS AT 4 PLANT STAGES (GM/KG OF DRY MATTER)

Location	kg/ha Treatment	6 Node		11 Node		16 Node		Podding	
		N	S	N	S	N	S	N	S
Garrick	0	47.1	2.4	49.4	2.8	45.5	2.7	31.7	1.9
	40	48.9	3.2	49.0	3.0	47.4	3.5	32.5	2.5
White Fox	0	47.3	2.4	53.5	3.2	42.0	2.2	33.2	1.7
	40	48.5	3.0	55.4	3.4	48.3	2.4	32.2	1.6
Nipawin	0	47.9	2.7	51.3	3.2	45.7	2.7	29.0	1.9
	40	47.1	3.3	54.4	3.4	43.3	2.6	28.4	2.0
Codette	0	52.2	2.8	54.4	3.5	42.7	2.4	32.1	2.2
	40	51.4	3.9	54.1	3.5	44.7	2.8	33.3	2.4
Pontrilas	0	42.3	3.5	44.7	2.8	30.4	1.7	29.9	1.7
	40	41.6	4.3	41.3	2.8	35.2	2.7	27.7	2.2
Sandhill	0	35.8	4.0	35.3	2.9	32.7	1.9	20.3	2.0
	40	36.4	3.8	39.6	4.9	34.2	4.3	19.7	2.9

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DISCUSSION

Grain yield results and analysis of variance is presented in Table 2 and Table 3 respectively. The time of application (Spring versus fall) had no significant (0.05) effect on yield. The method of application (band versus broadcast) had no significant effect on yield. The rate of the sulphur fertilizer had no significant effect on yield except for the Garrick location. At this location the 40 kg/ha SO_4-S was significant less than the 0 kg/ha and 30 kg/ha SO_4-S treatments.

Plant dry matter weight and the analysis of variance is presented in Table 4 and Table 5 respectively. The time of application and the method of application did not significantly dry matter weight. The rate of sulphur fertilizer did not significantly effect dry matter weight except for White Fox location where 0 kg/ha and 10 kg/ha of SO_4-S yielded significantly less dry matter than 20 kg/ha SO_4-S. Plant heights of field pea are presented in Table 6. With the exception of Garrick location, 0 kg/ha and 40 kg/ha SO_4-S treatments had similar vine lengths among sites.

The Garrick site 0 and 40 kg/ha SO_4-S treatments had vine lengths of 60 and 71 cm respectively.

In general, sulphur concentrations determined by plant tissue analysis; were greater for the 40 kg/ha SO_4-S treatment than the 0 kg/ha SO_4-S treatment. As the growth stages progressed from 6, 11, 13 nodes to podding stage, the differences with sulphur concentrations between 0 and 40 kg/ha SO_4-S treatments decreased.

The concentration of nitrogen in general was greater for the 40 kg/ha SO_4-S treatment then for the 0 kg/ha SO_4-S treatment.

Sulphur and nitrogen concentrations decreased as growth and development progressed due a dilution effect within the plants.

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FIELD PEA SULPHUR PROJECT PLOT LAYOUT

REP 5	SBd					FBd					SBc					FBc					
G. ROW	2	4	1	5	3	3	5	4	2	1	1	4	3	2	5	1	2	4	5	3	G. ROW
	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	

REP 4	SBd					FBc					SBc					FBd					
G. ROW	4	3	2	5	1	1	4	5	3	2	5	3	2	4	1	1	3	5	2	4	G. ROW
	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	

REP 3	FBc					SBd					SBc					FBd					
G. ROW	1	3	2	5	4	1	5	4	3	2	4	2	3	1	5	5	4	1	2	3	G. ROW
	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	

REP 2	SBc					FBd					SBd					FBc					
G. ROW	5	1	4	3	2	4	1	5	3	2	1	5	2	3	4	3	5	4	2	1	G. ROW
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	

REP 1	SBd					SBc					FBd					FBc					
G. ROW	1	2	3	4	5	3	1	5	2	4	4	2	5	3	1	4	2	3	1	5	G. ROW
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	

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